BOTANY.[1]

NOTES ON THE STUDY OF FUNGI.—In view of the increasing interest in the study of mycology in this country some general remarks on this subject may not be out of place. In the first place, of course, here as elsewhere the question of *utility* comes up. The reply to this question given by Batarra, an Italian botanist of the eighteenth century, is still applicable. In his "Fungorum Agri Ariminenses Historia," published in 1755, in the chapter concerning the utility of Fungi, he says:

"Since everything placed on the earth by the wisdom of the Creator has been created through some wise design, and since all other productions contribute in some way to the uses of living beings on the earth, it cannot rationally be denied that Fungi also were intended to serve some good purpose, for the ideas of the unlearned crowd who regard these productions as of no account, and think that the tribe of Fungi might all be destroyed without causing any derangement in the economy of nature, and without detriment to the living beings on the earth, cannot be accepted by those who believe that God and nature made nothing in vain. We have to admit that the utility to be found in Fungi is not of the highest, yet this is not the fault of these productions themselves, but arises rather from the pride of men and their unwillingness to spend time and thought on those things which God in His wisdom was not ashamed to make.

"To specify more definitely then, in the first place, Fungi furnish an abundant supply of food to many tribes of insects" [a plea which will find no great favor with agriculturists, I suspect], "nor are they to be rejected as a means of sustenance for man. The mushroom, for example, and the morrel and various other kinds of esculent Fungi furnish an article of diet highly prized even on the tables of the rich."

Thus far Batarra's reasoning has lost none of its force up to the present time. But whatever opinion we may hold as to the absolute utility of Fungi themselves, it is certain that recent investigations into the habits and mode of growth of some of the parasitic species have enabled us to combat with more or less success their ravages on our cultivated crops, though it must be confessed that our knowledge is not yet accurate enough to enable us to control them with any great success. The "potato rot," the "grape rot," the "cranberry rot," and the various blights, molds and mildews with which we have to contend still remain to vex and plague us, and it certainly requires much faith and a strong imagination to believe that these pests, the parasitic Fungi, really serve any good purpose in the economy of nature. Throwing aside, however, the question of their utility as one which cannot yet in all cases be satisfactorily answered, we

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

are safe in saying that the study of these minute organisms, presenting as they do such a vast variety of curious and beautiful forms, cannot fail to be of the deepest interest to the student of nature, and may yet lead to good results. To contribute then to this end and enlist perhaps new workers in the mycological field, it is proposed in some succeeding papers to notice briefly some of the microscopic Fungi, their habits and places of growth, and the way to find them out.

Among the earliest Fungi to appear in spring are the Aecidiums. These are little yellow cups, appearing on living or partly-dead leaves of various plants, generally on the under surface of the leaf, and mostly in groups or clusters on discolored and swollen spots or blotches, and are filled with the dust-like subglobose yellow spores. Generally the upper surface of the leaf directly opposite the clusters or cups below is also discolored, yellowish or reddish, and this discolored area, when examined with a lens, shows on its surface numerous minute slightly-projecting pustules, which are found, when examined with a microscope of higher power, to be filled with a multitude of minute granular spores, produced from the tips of numerous slender densely-crowded filaments, which arise from the inner surface of the cavity of the aforesaid pustules, which are technically called spermogonia from two Greek words signifying *spore generators*. Just what part these spermogonia play in the growth cycle of the fungus to which they belong is not yet certainly known. They are, however, intimately connected with the Aecidium, which again is now considered as only the first of three stages of growth of a polymorphic, or rather trimorphic fungus, of which the last and highest stage (teleutospores) is a Puccinia or Uromyces. In many species there comes in between these two another form called Uredo, of which the spores, very similar to those of the Aecidiums, are produced in subcuticular clusters not contained in cups as in Aecidium, but which, when the cuticle which at first covers them soon breaks away, are exposed on the surface of the leaf, which, from this cause, appears as if covered with little heaps of yellow, or reddish-yellow dust. The Aecidium and Uredo are oftener on the under surface of the leaf, but sometimes on both sides.

If now one wishes to *see* some of these curious productions of which so much has been written within the past few years, it is only necessary to provide an ordinary pocket lens, such as may be had at the opticians for twenty-five or fifty cents, and a tin box or pail with a tight-fitting cover, in which fresh leaves or flowers may be kept without wilting and brought home for further examination, and go out into the nearest field to see what can be found. At this date (May 21st) the leaves of the various species of Ranunculus may be examined for *Aecidium ranunculacearum*, which is now beginning to appear. The same species is also to

be found on *Anemone nemorosa* and Thalictrum. The affected leaves are easily recognized by the pale or faded spots on their upper surface, on which may be seen with the lens the minute spermogonial pustules, and on turning the leaf the cluster of cups, light colored and mealy outside and bright orange-yellow within, will at once be seen. Another form occurs on the *Ranunculus abortivus*, which was named by Schweinitz *Æcidium ranunculi*, but which he afterwards united with the first-mentioned species. It differs from the ordinary form in the cups being rather larger and less prominent, and perhaps of a deeper color inside, but more especially in having the cups quite evenly distributed over the lower face of the leaf, and not collected in clusters.

The leaves of the blue forget-me-not (*Houstonia cærulea*) also now begin to show a very beautiful little Æcidium (*A. houstoniatum* Schw.), of which the cups are much smaller than those of the species on Ranunculus, and more inclining to red inside. They are also more evenly scattered over the under surface of the leaves, which are scarcely discolored above. There is also now to be found on the leaves of the spring beauty (Claytonia) a very fine little Æcidium, which will be succeeded a little later by a Puccinia.

In June there will be found on the leaves of the common barberry bush (*Berberis vulgaris*) another Æcidium, which has been proved by actual experimental cultures to be only one stage of growth of the common wheat rust (*Puccinia graminis*). Among others, Dr. C. B. Plowright, of King's Lynn, England, has demonstrated this fact by a series of artificial cultures, the particulars of which he has published in the *Gardener's Chronicle* (1882). He finds that the spores of *Æcidium berberidis* placed on the leaves of a living wheat plant produce the common wheat rust (*Puccinia graminis*), the Uredo first, then the Puccinia, and that the Puccinia spores placed on the living leaves of the barberry produce *Æcidium berberidis*, and thus complete the circle. By similar experimental cultures it still remains to be shown to what particular Puccinia the various Æcidiums and Uredos belong, as the actual connection of many of them has not yet been shown, though it is probable that every Æcidium has its corresponding Puccinia.

But if none of the above-mentioned plants are to be found the common dandelion (*Taraxacum dens-leonis*) is to be met with almost everywhere, and affords a very fine little fungus. The leaves even to the naked eye will be seen to show on both surfaces little brown specks, which, when examined with the lens, appear like little heaps of brown dust, surrounded by the ruptured epidermis of the leaf. This dust is the spores of a Uredo, which is the forerunner of a Puccinia that will appear later in the season on the leaves of various composite plants, and has hence been called *Puccinia compositarum.* These Uredo spores, when

examined under a compound microscope, are found to be studded all over with fine projecting points, which give them a very neat appearance.—*J. B. Ellis, Newfield, N. J.*

ANALYSIS OF VEGETABLE TISSUES.—Frémy classifies the constituents of vegetable tissues as follows, the characters being derived from their chemical constitution (*Ann. Sci. Nat.* XIII, 1882):

1. *Cellulose Substances.*—In this group are included all those constituents of vegetable tissues which dissolve without coloring in bi-hydrated sulphuric acid, producing dextrine and sugar; which are not sensibly altered by alkaline solvents, and which resist for a long time the action of energetic oxidizers. Schwitzer's reagent (ammoniacal copper oxide) enables at least the three following varieties to be distinguished:

(*a*) *Cellulose.*—Dissolves immediately in the copper reagent. This constitutes the larger part of cotton hairs and of the utricular tissues of certain fruits.

(*b*) *Paracellulose.*—Dissolves in the copper reagent only after the addition of an acid. This constitutes the utricular tissue of certain roots, and the epidermal cells of leaves.

(*c*) *Metacellulose.*—Insoluble in the copper reagent even after the addition of acids. It occurs principally in the tissue of fungi and lichens, and is the "fungine" of Braconnot.

2. *Vasculose.*—This is the substance which enters most largely into the composition of vessels and tracheids. It usually accompanies cellulose substances, but differs from them completely in composition and properties, containing more carbon and less hydrogen. It is the substance which in certain cases unites the cells and the fibers. It sometimes occurs on the exterior of tissues in the form of a continuous, resisting and horny membrane. It forms, in fact, the solid part of woody tissues; it is abundant in hard woods, and in the sclerenchymatous concretions in pears; the shells of nuts and the stones of stone-fruit often consist of this substance to more than half of their weight. Vasculose is insoluble in bi-hydrated sulphuric acid, and in the copper reagent; it does not dissolve sensibly at the ordinary pressure in alkaline solvents, but only with the assistance of pressure. This important property is utilized in the manufacture of paper from straw and wood. It dissolves rapidly in oxidizing substances, as chlorine water, hypochlorites, nitric acid, chromic acid, permanganates, etc. Before dissolving it, oxidizers change it into a resinous acid, soluble in alkalies. Cellulose substances can be removed from vasculose by the solvent action on them of bi-hydrated sulphuric acid, or Schweitzer's reagent. If, on the other hand, these substances have to be freed from vasculose, the tissue is subjected for several hours to the action of nitric acid diluted with its volume of water in the cold, which does not act sensibly on cellulose substances, while it transforms the vasculose into a yellow

resinous acid, which can then be dissolved out by means of an alkali.

3. *Cutose.*—This substance constitutes the fine transparent membrane which forms the surface of the ærial parts of plants; the "suberine" of Chevreul is a compound of cutose and vasculose. It possesses several characters in common with vasculose, resisting the action of bi-hydrated sulphuric acid, but it is soluble at the ordinary pressure in dilute or carbonated solutions of potassa and soda. It contains more carbon and hydrogen than vasculose. Subjected to the action of nitric acid it gives rise to suberic acid. To separate cutose from the cellulose substances, and from vasculose, the copper reagent is first used to dissolve the former, and the tissue is then agitated with potassa at the ordinary or at a higher pressure, the former dissolving the cutose, and the latter the vascular.

4. *Pectose.*—This substance is insoluble in water, but is dissolved by the action of dilute acids, and converted into pectine. It occurs ordinarily in the atricular tissues of roots and fruits, and is recognized by subjecting the tissue with heat to the action of dilute hydrochloric acid; it then forms pectine, which dissolves in the water, and can be precipitated by alcohol.

5. *Calcium pectate.*—This salt is often the basis of a tissue which occurs in the form of a continuous membrane, serving as in the pith of certain trees to bind the cells together. If this salt is decomposed by an acid, the tissue is immediately disintegrated into its constituent cells. Its determination is effected by heating the tissue in the cold with dilute hydrochloric acid, which decomposes the calcium pectate, leaving the pectic acid in an insoluble state; this is then heated with a dilute solution of potassa, producing a soluble pectate which can be again decomposed by acids.

6. The *Nitrogenous substances* contained in vegetable tissues are dissolved by alkalies.

7. The *Inorganic substances* constitute the ash after calcination.

In woods the proportion of vasculose increases with their hardness and density. The proportions of cellulose and paracellulose vary in stems; pine wood appears to be composed exclusively of paracellulose and vasculose. The parenchyma of the pith often contains considerable quantities of pectose and calcium pectate. Cork consists partly of "suberine," and is composed of cutose and vasculose. In leaves and petals the parenchyma consists of cellulose and pectose, the vascular bundles and vessels of vasculose and paracellulose. The utricular tissue of petals is composed almost entirely of cellulose, thin spiral vessels almost entirely of vasculose.

Vasculose can be obtained in special purity from the pith of the elder. After treating with dilute alkali it is boiled with dilute hydrochloric acid in order to transform the paracellulose into

cellulose; the ammoniacal copper reagent is then used, and the treatment repeated eight or ten times until no further reaction ensues. The pure vasculose thus obtained preserves a light yellow tint, maintaining the structure of the original tissue. The mean of several analyses of vasculose gives a composition corresponding to the formula, $C_{3}H_{2}O_{16}$.—*Jour. Royal Mic. Soc.* for April, 1883.

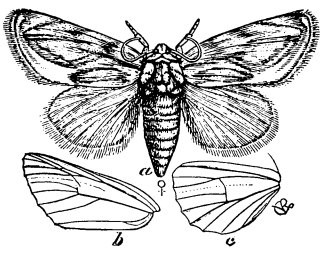
A CHINESE GYMNOCLADUS.—When Bentham & Hooker's first volume of the Genera Plantarum was written, the genus Gymnocladus was supposed to contain but one species, *G. canadensis*, the well-known "Kentucky coffee tree" of the Mississippi valley. Recently, according to the *Gardener's Chronicle*, a second species has been discovered in China, named by Baillon *G. chinensis*. From its description it appears to be much like our native species. Its leaflets are said to be more numerous, narrower, and not acuminate, and the pod is thick (3–4 inches long) and but slightly compressed. The shells, when steeped for a couple of days in water, yield a saponaceous substance which is used for washing. Do the pods of our species contain this property?

BOTANICAL NOTES.—*Puccinia buxi*, the box rust, is figured by W. G. Smith, in a recent number of the *Gardeners' Chronicle*.——Joseph Schrenk, in the April *Torrey Bulletin*, gives details of the structure of the haustoria of *Comandra umbellata*, accompanied by three plates. He shows that in this case "there exists a direct and unobstructed communication between the cells of the haustorium and those of its foster root."——In the same number, E. L. Greene describes five new species of Western plants, Dr. Vasey two new Western grasses, and Professor Tuckerman a new California lichen (*Ramalina crinita*).——A new Phallus (*P. togatus*) from Eastern Pennsylvania is described and figured in the May *Botanical Gazette*.——S. E. Cassino & Co., of Boston, announce that the manuscript of the long-promised Manual of North American Mosses, by Lesquereux and James, is completed, and in the printers' hands. It will be uniform with Gray's Manual, and will contain copper-plate illustrations. It is to be issued in the autumn.——M. E. Jones, the well-known botanical collector of Salt Lake City, Utah, has issued a thirty page pamphlet, descriptive of the ferns of the West. A few pages are given to general structure, after which follow specific descriptions of the genera and species which occur in the region from Nebraska westward. Altogether 108 species are described of which seven are Ophioglossaceæ, the remainder being true ferns (Filices).——Recent numbers of the *Botanische Zeitung* contain a valuable paper (with a plate) on cell division in Closterium.——J. G. Lemmon has issued a pamphlet of twenty-three pages on the discovery of the potato in Arizona, being the substance of a paper read before the California Academy of Sciences January 15, 1883.

——Professor Sorokine, of the University of Kazan, Russia, has begun the publication of a mongraph of the Chytridiaceæ, in the *Archives Botanique du Nord de la France.* It promises to be of great value. Each species is illustrated by wood cuts in the text.

ENTOMOLOGY.[1]

A UNIQUE AND BEAUTIFUL NOCTUID.—The accompanying figure represents one of the most striking and unique of our N. A. Noctuids in respect of color and pterogostic design, the general color being of a bright golden-yellow, and the lines and shades of a deeper gold, inclining to ferruginous or even ochreous.



Cirrophanus triangulifer Grt. *a*, male; *b*, *c*, venation of front and hind wings (after Riley).

Many years ago we had in our collection a single male specimen of this moth which was captured in August on hickory at Kirkwood, Mo. In 1871 we submitted it to a number of lepidopterists both in this country and in Europe, when, finding that it was unknown and could not well be referred to any defined genus, we gave it a MS. name, hoping some day to obtain the female. In the summer of 1872 Mr. A. R. Grote visited St. Louis during our absence, and was courteously granted permission by an assistant to go over our collection. He made various notes thereon, and among others took a hasty description of this unique moth. This description was at once published in the *Canadian Entomologist* (IV, Oct., 1872, p. 187) under the name of *Cirrhophanus triangulifer*, nov. gen. et sp., and, like all generic descriptions dashed off under such conditions, and without real study, was quite imperfect, all important structural details being omitted, and some of the characters given belonging to the male only. The description was accompanied by a statement of forgetfulness as to the source of the type, which, considering the fact that we were pretty well known to Mr. Grote at the time, and that our collection was the only general collection of insects in St. Louis, may be taken, perhaps, as illustrative of the effects of the "new infidelity" which he has preached.

The moth was redescribed in June, 1875, by Mr. H. K. Morrison as *Chariclea pretiosa* (Proc. Bost. Soc. Nat. Hist. XVIII, p. 122), while Mr. Grote amplified his own description in October of the same year (Proc. Ac. Nat. Sc. Phil. 1875, p. 421). It is, however, to the affinities of the species that we wish to direct attention. Grote at first allied it with Gortyna, leaving a wide

[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc. should be sent.